



UNIVERSITY OF SWAZILAND
Faculty of Health Science

Department of Environmental Health
Science

Supplementary Semester I1 Examination
July 2012

Title of paper: Acoustics and Health

Course code: EHS 570

Time allowed: 3 HOURS

Marks allocation: 100 Marks

Instructions:

- 1) ANSWER **ANY FOUR QUESTIONS**
- 2) Question 1 is multiple choice
- 3) Each question is weighted 25 marks
- 4) Write neatly and clearly
- 5) Formulas and other useful data have been provided with this paper

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PERMISSION TO DO SO HAS BEEN GRANTED BY THE
CHIEF INVIGILATOR

QUESTION 1

I.

Multiple choice: Write True or False against each letter corresponding to the following statements as they apply to acoustics.

- (a) The location of the source of sound does not influence the directivity of the sound emission.
- (b) If the noise level is steady throughout the exposure period, then a direct measurement of the A-weighted sound pressure level provides an adequate basis for determining exposure.
- (c) Where the noise level fluctuates, as happens in most industrial situations, the concept of the equivalent continuous sound level is used.
- (d) The most significant danger from noise is its inability to damage the sense of hearing.
- (e) The risk of hearing loss from high noise environments depends on both the level of noise and the length of time an individual is exposed at that level.
- (f) In the steady state, the power supplied to the reverberant field of the receiving room must be exactly balanced by the power loss at the walls of the receiving room.
- (g) The exposure of individuals who move randomly around areas of different noise level can only be satisfactorily monitored with a personal noise dosimeter.
- (h) For determining the need for hearing conservation programs, all sound at or above 80 dBA are used in the calculation. If the calculated dose exceeds 0.5 (TWA > 85 dBA), employees must be included in a comprehensive hearing conservation program.
- (i) The reverberation time is the time taken for the intensity of a sound to be reduced to one billionth of the level existing when the source was switched off.
- (j) Under certain conditions the projected wavelength of the incident sound can be in the walls. This condition is known as coincidence, and when it occurs it gives rise to a marked reduction in the effective insulation.

(20 marks)

II.

List five (5) risk factors that affect the degree and extent of hearing loss

(5 marks)

QUESTION 2

Describe the following noise control measurements as applied in Acoustics and health.

- a) Administrative controls (3 marks)
 - b) Engineering controls (8 marks)
 - c) Reduce driving force (5 marks)
 - d) Reduce response of vibrating force (5 marks)
 - e) Reduce radiation efficiency by reducing area of vibrating surface (4 marks)
- (25 marks)**

QUESTION 3

- (a) An office is separated by a partition wall of area 100 m^2 having a sound reduction index of 40 dB. A door of area 2.5 m^2 having a sound reduction index of 30 dB is added to the partition. If the room adjoining the office has sound pressure level of 75 dB, find the sound pressure level in the office when the door is closed and when it is open.

(10 marks)

- a) A $5 \text{ m} \times 10 \text{ m} \times 3 \text{ m}$ room has a 1 microwatt ($1 \mu\text{W} = 10^{-6} \text{ watts}$) sound source located in the centre of the 5 m wall where the floor and the wall meet. The absorption coefficients associated with the room are: walls $\alpha = 0.02$, floor $\alpha = 0.1$ and ceiling $\alpha = 0.26$. Find the sound pressure level at the centre of the room first taking into account the presence of the reverberant field and then assuming only direct sound radiation from the sound source.

(10 marks)

- b) Describe a sound level meter and its functions.

(5 marks)

QUESTION 4

- a) An employee is exposed to the following noise levels during the workday:
- 85 dBA for 3.75 hours
 - 90 dBA for 2 hours
 - 94 dBA for 2 hours
 - 95 dBA for 0.25 hours

Calculate the daily dose and give your conclusion about the exposure.

(5 marks)

N.B The permissible noise exposures are as follows:

Duration per day	Sound level (dBA)
8	90
6	92
4	95
1½	102
1	105
½	110
¼	115

- b) What are the purposes of a detailed survey?
(5 marks)
- c) Sound waves of sound power level 70 dB are incident on the a concrete wall. Assuming 1/10000 of the incident energy is transmitted through the wall, find the sound reduction index of the wall and the reduced sound power level.
(5 marks)
- d) The dimensions of a room are: 10 m x 10 m x 4 m high and the absorption coefficients for the ceiling, walls and floor are 0.6, 0.15 and 0.21 respectively. If a noise source, which has a sound power output of 15.8 mW, is located in one corner of the room, determine the steady-state sound pressure level at a distance of 2.5 m from the source.

(10 marks)

QUESTION 5

a) Using table 20.9 provided determine:

i) The total absorption before treatment at 1000Hz;

(6 marks)

ii) The total absorption after treatment at 1000Hz and

(6 marks)

iii) The noise reduction for a room with the following characteristics.

(3 marks)

Room	13m x 14m x 4m
Volume	728 m ³
Ceiling	plaster – 182 m ²
Floor	concrete – 142 m ²
Floor	carpet – 40 m ²
Walls	painted brick – 216 m ²

b) Describe the elements of the basic plan for determining compliance with occupational safety and Health administration noise survey.

(10 marks)